

ECOS Inquiry Template

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2. NAME OF INQUIRY: TESTING HYPOTHESES ABOUT PLANT DIVERSITY

3. GOALS AND OBJECTIVES:
 - a. Inquiry Questions:
 1. What area of the schoolyard contains the most different type of plants?
 2. What is the average number of plants found in each area of the schoolyard?
 3. What types of plants are found in the schoolyard?
 - b. Ecological Theme:
 1. Plant diversity can vary over small scales, and can be influenced by topography, land use, etc.
 - c. General Goal: Introduce students to the concept of random sampling, build observation skills, practice averaging, and introduce the On-Line Plant Guide.
 - d. Specific Objectives:
 1. Students will practice making and testing hypotheses, hone observation skills, and (if they are at the appropriate skill level) describe scientific results through graphing.
 2. Students will learn that areas that seem to contain only one type of plant (e.g. a well-kept grassy area) often actually contain several different types of plants when they are closely observed.
 3. Students will practice using the ECOS plant guide by attempting to identify their pressed plants.
 - e. Grade Level: 4
 - f. Duration/Time Required
 - Prep time: 1 hour
 - Implementing Exercise During Class: Two 90-minute class periods
 - Assessment: 20 minutes

4. ECOLOGICAL AND SCIENCE CONTEXT:
 - a. Background (for Teachers): Except for in the case of well-manicured, fertilized lawns, landscapes do not generally consist of a single plant species. Also, different plants will be found in different locations. These differences can be due to a number of habitat variables, including microclimate, soil, use of herbicides, and sunlight. For example, the side of a slope that receives direct sun will often be drier than the shaded side, and therefore will contain more drought-tolerant plants. A depression in the landscape may collect water, and contain plants and trees that thrive in wet environments.

While this inquiry will allow students to discover how plant diversity differs across a landscape, it will also teach students how to make legitimate, scientific measurements and describe their data. Experiments often start with a hypothesis, and because students will be familiar with their schoolyard, they should already be aware that different places in the schoolyard contain different types of plants. Students will ask the question: which area contains the most type of plants, and which contains the fewest.

b. Background (to present to Students): **Before the activity:**

This inquiry will be most effective and appropriate if it follows a series of observation and description inquiries. The students should have been outside in the schoolyard looking for different kinds of plants and animals. They should be aware of some of the most common or most interesting types of plants in the schoolyard.

It is possible to introduce the ECOS on-line plant guide to the students before the activity, but this can also be done after. If the guide is introduced prior to the activity, the students can be shown the website by scrolling through the list of common plant names (<http://www.bioed.org/nhguideweb/NHGuide/PlantGuide.aspx>). Students should pick out plants that they know, and then read through parts of the description. Focus especially on the “Did You Know” section, as they will likely find this the most interesting. If the guide is introduced at this stage, it should be presented as a cool website where students can learn neat facts about plants. (You can focus on the methods of how to identify specific plants at the end of the activity).

After the activity: While discussing student results, have them also describe the environment in which they sampled. Was it warm or cold? Sunny or shady? On a hillside? In a mowed lawn? Was there an impact from livestock or other students? These factors could influence the types of plants found in an area.

5. **MOTIVATION AND INCENTIVE FOR LEARNING:** This is a fun and engaging activity that gets students outdoors, down on their hands and knees picking plants. All students get a chance to participate in looking within their plot for unique types of plants. They may be amazed by some of the plants they find. Using the ECOS plant guide to identify their plants is also fun, as they will learn all sorts of interesting facts about the plants in their schoolyard.

6. **VOCABULARY:**

Microclimate - climatic conditions in a relatively small area

Plot - the area within the hula hoop in which students will sample plants

7. **SAFETY INFORMATION:**

Outdoor management may be difficult if the students are working in separate groups separated far apart. If this is the case, then the entire class can stay together in each area of the schoolyard. Small groups can each sample one smaller plot within the area and plant counts can later be averaged. The whole class can then move on to another part of the schoolyard. The activity will take more time this way, but may be more manageable.

8. **MATERIALS LIST (including any handouts or transparency masters):**

Schoolyard map or areal photo (one per group)

Data sheet (attached)

Cardboard and newspaper to make plant presses (see “A Simple Plant Press” attached)

Baggies (2-4 per group) to collect plant parts in each plot

Hula hoops or similar sized object for defining plot (at least one per group)

9. **METHODS/PROCEDURE FOR STUDENTS:**

a. Pre-investigation work:

1. Begin by asking students to describe different locations in the schoolyard. A map or photo may be useful here. Then ask them if they expect to find the same kinds of plants

in each area. Ask them to hypothesize where they might find the most and the fewest types of plants. (Remember, if they predict that all areas of the schoolyard will have the same kinds and numbers of plants this is OK; it is still a hypothesis). Also remind them that grass counts as a plant, and that there may be different types of grasses. They should write their hypothesis on the datasheet. Tell them that in order to test their hypothesis, they will go outside and count the plants in each area (this works best if the class is divided into groups and each group takes one area).

2. Ask them if they should search the entire area, which might be rather large. Ask them what would happen if one group searched a really big area and another group searched a really small area. (Answer: the group searching the larger area would be likely to find more types of plants, and it would be difficult to compare counts between the two plots). Each group will therefore need to search areas of equal size (hula hoops work well for establishing the plots).

3. Point out that if they “search” for an area that has a lot of plants, they might bias their sampling. Instead, they should randomly select the plot within their area of the schoolyard by closing their eyes and throwing the hula hoop. (This is a lot of fun, and each student will likely want a chance to throw the hula hoop).

b. Investigation work:

1. Each group should go to their pre-selected area of the schoolyard. One student should close their eyes and throw the hula hoop. Wherever it lands, all students in that group should pick a large piece of every type of plant inside the hoop and place it in one baggie. Do not pick the entire plant, but pick enough (leaves, stem, flowers) so that it can later be identified. The picking will require group work so that they are sure they have picked every plant inside the hoop. Be sure not to go outside of the hula hoop.

2. When finished, another student can throw the hoop again within their area, and the group can repeat the process, picking plants and placing them in a separate baggie. This can be repeated as often as time permits, using a new baggie for each throw. The idea is to sample this area of the schoolyard many times, and then get an average number of plants.

3. Back in the classroom, each group should open the first bag and separate out all of the different kinds of plants. Work with only one bag at a time so the samples do not get mixed up. They should enter the number of plants collected on their data sheet.

4. After they have counted their plants, they can make a plant press by placing several sheets of newspaper between two layers of cardboard. The plants should be laid out (not overlapping) on the newspaper, additional newspaper should be placed on top of the plants, and the cardboard on top of that (see attached diagram). These should be set aside with books stacked on top to apply pressure, and left alone for at least one week.

The following steps can be done during the next class period:

5. Ask each group how many plants they found in each area. If they threw the hula hoop more than once, chances will be good that they will obtain different counts. If the students are familiar with calculating averages, list the plant counts for each group on the

board and calculate the average number of plants for each schoolyard area. NOW, revisit the hypothesis and ask them if their first hypothesis was correct (remind them that it is ok if their initial guess was wrong – that just means they have learned something that they didn't know before). Next, ask each group how close they were in their second hypothesis (how many plants did they expect to find in their plot).

6. After the plants have been in the plant press for at least one week, remove them and remind students about the ECOS-On-Line Plant Guide. Students should then attempt to identify as many of the plants as possible, using the On-Line Plant Guide. The pressed plants can be glued onto a sheet of poster board, and labeled with their name and other interesting information. Be sure that students also include information on where the plant was collected (the area of the schoolyard in which they were sampling)!

10. **ASSESSMENT:** Ask each group to present their results. Ask why it was necessary to calculate the average (so one number could be used to describe the number of plants in each plot) and why we used hula hoops (so that everyone sampled an equal area). Finally, each student should write about their experience and results in a journal or on a separate sheet of paper.

11. **EXTENSION IDEAS:** If students are familiar with Excel, they can use the computer to graph their results. If not, you can still have them practice graphing on paper. Compile all class data (average number of plants found in each area of the schoolyard) and graph the different parts of the schoolyard on the x-axis and the average number of plants collected on the y-axis. Discuss why graphs are useful for showing data (because they allow you to compare the data just by looking at it, rather than reading or comparing numbers).

12. **SCALABILITY:** Older students can sample more plots in each area, and calculate the average of (for example) five plots instead of two. They can calculate the actual area of the sampling plot by measuring the circumference and diameter of the hula hoop. Have each student select one of the plants that was in their plot and, using both the On-Line Plant Guide and other internet and library research, write a report on the plant, where it is found, uses by humans, etc.

13. **REFERENCES:**

<http://www.nationalgeographic.com/xpeditions/lessons/08/g68/prairies68.html>

<http://www.bioed.org/nhguideweb/NHGuide/PlantGuide.aspx>

14. **LIST OF EXPERTS AND CONSULTANTS**

Paul Alaback

15. **EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:**

Students really enjoyed looking at aerial photos of the schoolyard, and talking about where they expected to find the most plants. They enjoy throwing the hula hoop and sorting out the different plant types. Our students were taught averaging the week of this activity, so this was good practice in calculating averages in a different (non-math) context. This lesson sparked several questions from students regarding other places where averages are used, and asking the teacher if she used averages in “real life.”

Making Hypotheses About Plant Diversity

Names of group members:



1. In what part of the schoolyard do you expect to find the most types of plants (what is your hypothesis)?

2. What area of the schoolyard will your group sample? _____

3. How many types of plants do you predict you will find in your schoolyard area (what is your hypothesis)? _____

Data Sheet:

Describe the area where you collected your plants. Was it dry, wet, cold, hot, hilly, flat?

Number of plants collected from the first hula hoop throw: _____

Number of plants collected from the second hula hoop throw: _____

A Simple Plant Press

